

2008

A study of compliance in aged care facilities with regards to Australian Standards 1851:2006 maintenance of fire protection systems and equipment section 17

Robert Doleman
Edith Cowan University

Follow this and additional works at: https://ro.ecu.edu.au/theses_hons



Part of the [Health Services Administration Commons](#), and the [Occupational Health and Industrial Hygiene Commons](#)

Recommended Citation

Doleman, R. (2008). *A study of compliance in aged care facilities with regards to Australian Standards 1851:2006 maintenance of fire protection systems and equipment section 17*. https://ro.ecu.edu.au/theses_hons/1021

This Thesis is posted at Research Online.
https://ro.ecu.edu.au/theses_hons/1021

Edith Cowan University

Copyright Warning

You may print or download ONE copy of this document for the purpose of your own research or study.

The University does not authorize you to copy, communicate or otherwise make available electronically to any other person any copyright material contained on this site.

You are reminded of the following:

- Copyright owners are entitled to take legal action against persons who infringe their copyright.
- A reproduction of material that is protected by copyright may be a copyright infringement. Where the reproduction of such material is done without attribution of authorship, with false attribution of authorship or the authorship is treated in a derogatory manner, this may be a breach of the author's moral rights contained in Part IX of the Copyright Act 1968 (Cth).
- Courts have the power to impose a wide range of civil and criminal sanctions for infringement of copyright, infringement of moral rights and other offences under the Copyright Act 1968 (Cth). Higher penalties may apply, and higher damages may be awarded, for offences and infringements involving the conversion of material into digital or electronic form.

USE OF THESIS

The Use of Thesis statement is not included in this version of the thesis.

**EDITH COWAN UNIVERSITY
LIBRARY**

**A Study of Compliance in Aged Care Facilities With Regards to Australian
Standards 1851:2006 Maintenance of Fire Protection Systems and Equipment
Section 17**

Robert Doleman

**Thesis submitted to the Faculty of Computing, Health and
Science**

**Edith Cowan University, Joondalup
for the
Bachelor of Science (Honours)**

July 2008

ABSTRACT

The management of risk within a nursing home environment is widely viewed as an undertaking performed by the owners or managers of nursing homes. The residents of these homes are reliant upon the owners and managers to keep them safe, due in part to a traditional belief that they are the experts and have a greater understanding of risk. To establish risk it is first a requirement to have an understanding of levels of risk and risk management techniques. Risk appreciation is often influenced by heuristic representativeness, as well as social and cultural influences. The higher level of risk within a nursing home environment is due in part to the demographic of the residents as well as health issues experienced by elderly people. This increase in risk level places a greater importance on risk mitigation systems. Fire and smoke doors form a pivotal part of the defence in depth principles central to risk minimisation and therefore need to be maintained in order to perform correctly.

The study measured aspects of fire and smoke door maintenance compliance by undertaking audits on 160 doors in 22 nursing homes within Western Australia. The results of the auditing process were then evaluated to establish the non-compliance levels. The results were set against the research question to allow interpretations and assumptions to be made.

The study demonstrated a non-compliance level of 87% on the fire and smoke doors audited, with 935 failure items identified. The study also demonstrates that despite the requirement for nursing homes to be accredited and audited, there are still unacceptably high levels of non-compliance. As a result of the study's findings, assumptions were able to be drawn to the increased risk exposure for residents and staff with consideration made on the reasons for such a high rate of non-compliance.

Copyright and Access Declaration

I certify that this thesis does not, to the best of my knowledge and belief:

- (i) incorporate without acknowledgement any material previously submitted for a degree or diploma in any institution of higher education;*
- (ii) contain any material previously published or written by another person except where due reference is made in the text; or*
- (iii) contain any defamatory material*

Signed _____

Date 4th November 2008.

TABLE OF CONTENT

CHAPTOR 1: INTRODUCTION.....	1
1.1 Introduction.....	1
1.2 Back Ground of the Study.....	2
1.3 Significance of the Study.....	2
1.4 Literary Review.....	4
1.5 Financial Cost of Fire.....	4
1.6 Study Design.....	5
1.7 Study Methodology.....	5
1.8 Study Validity and Reliability.....	6
1.9 Data Collection and Analysis.....	6
1.10 Findings and Conclusion.....	6
 CHAPTER 2: LITRATURE REVIEW.....	 7
2.1 Introduction.....	7
2.2 Aged Care.....	8
2.2.1 Australian Heath Patterns.....	8
2.2.2 Aged Care in Australia.....	9
2.2.3 Fire Death Risks among Older Adults.....	10
2.2.4 Vulnerability Increases with Age.....	11
2.2.5 Risk of Medical Oxygen.....	12
2.2.6 Staff and Patients.....	12
2.2.7 The Cost of Fires in Australia.....	13
2.2.8 Fires in Nursing Homes, Residential Board and Care Facilities.....	13
2.2.9 Fire Detection and Suppression.....	14
2.3 Nursing Homes.....	14
2.3.1 Nursing Home Accreditation.....	14
2.3.2 Aged Care Standards and Accreditation Agency (ACSA).....	16
2.3.3 Aged Care Funding.....	17
2.4 The Building Code of Australia.....	18
2.4.1 BCA from a Risk Management Perspective.....	19

2.4.2	Australian Standards 1851 Maintenance of Fire Protection Systems and Equipment.....	20
2.4.3	Australian Standard AS4655:2005 Fire Safety Audit.....	21
2.4.4	Australian Standards AS1905.1:2005 Fire Resistant Door Sets.....	21
2.5	Security.....	22
2.5.1	Risk.....	22
2.5.2	Cultural Risk.....	25
2.5.3	Risk Toleration.....	25
2.5.4	Risk Communication.....	26
2.5.5	Risk Management.....	28
2.5.6	Fire Risk Management.....	29
2.6	Conclusion.....	29
CHAPTER 3: MATERIALS & METHODOLOGY.....		32
3.1	Introduction.....	32
3.2	Study Design.....	32
3.2.1	Context.....	34
3.2.2	Design.....	34
3.2.3	Auditing Process.....	35
3.2.4	Pilot Study.....	35
3.2.5	Analysis.....	36
3.3	Validity and Reliability.....	36
3.3.1	Validity.....	37
3.3.2	Reliability.....	38
3.4	Ethics.....	39
3.5	Population Sample.....	39
3.6	Conclusion.....	41

CHAPTER 4: DATA COLLECTION ANALYSIS AND INTERPRETATION.....	41
4.1 Introduction.....	42
4.2 Auditing Process.....	42
4.3 Study Analysis.....	43
4.4 Study Interpretation.....	45
4.4.1 Research Question 1 Fire Door Compliance.....	45
4.4.2 Research Question 2 Risk Exposure through Non-compliance.....	47
4.5 Conclusion.....	49
CHAPTER 5: FINDINGS, RECOMMENDATIONS AND LIMITATIONS. 50	
5.1 Introduction.....	50
5.2 Summery of the Conclusions.....	50
5.3 Recommendations.....	52
5.4 Limitations of the study.....	53
5.5 Further Research.....	54
5.6 Conclusion.....	55
REFERENCES.....	59
 APPENDIX	
APPENDIX A: Auditing Spread Sheet.....	67

LIST OF TABLES

Table 2.1 Australian Building Class's.....	9
Table 3.1 Sample Audit Spreadsheet.....	36
Table 4.1 Completed Auditing Spreadsheet.....	45

LIST OF FIGURES

Figure 2.1 Risk Management within Aged Care.....	9
Figure 3.1 Study results procedures.....	34

CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter provides an overview of the study structure by considering the literature reviewed as part of the background to the subject matter covered within the study. It also considers the background to the study, as well as the study's significance. The design of the study and the processes involved in the auditing process, data collection and review were reviewed. The chapter culminates in the data assessment against the study research question to introduce findings of the study.

1.2 Background of the Study

The demographic of the country is set to change over the next half century, with life expectancy and a reduction in birth rate being responsible for the increase in the age of the population. The change in the demographic landscape is set to effect the fabric of society and the needs required by a continually ageing population. Demands upon health care is at the forefront of the way in which services providers will need to adapt to accommodate this change in the populations age, according to figure released by Department of Health and Aged (2006). In 2005, 312,000 Australians were aged 85 and over, equivalent to 1.5% of the population. By 2055 this group will increase to over 1.6 million people or 6% of the population. Over the next 20 years, the number of Australians who are 70 and over will grow at a rate 3.3 times faster than the growth of total population (Australia Government, 2006). These changes in the Australian population will be gradual, but inexorable and will result in 2040 having a much more equal distribution of population across all age groups.

The ageing of the population is caused by two factors: decreasing birth rates and longer life expectancy. Longer life expectancy means that the number of people aged 80 and over will double over the next two decades and triple over the next 50 years to comprise over 10% or 2.9 million people in 2055 (Productive Commission, 2005). At the last 2002 census (Australia Government, 2006) there were only 2,503 people aged 100 and over, by 2055 it is estimated that there will be 78,000 people within that age group. A person aged 70 years has a 36% chance of needing high level aged care and of those that do, most use care that is provided while remaining in their own homes. The remaining are cared for through residential and rest-bite centres (Australia Government, 2006).

The changes within the demographic will place further pressures upon the aged care industry. The increased number of places required to accommodate the increase in elderly people will have an effect of increasing the risk level associated with each facility. Age care facilities by their nature care for people of the age that have some degree of disability, whether it is hearing loss or a requirement for assistance with mobility. The need for evacuation in the event of a fire will require either a protracted period of time or large number of staff to evacuate the building.

In Australia the total cost of fire in 2003 was \$8,500 million, equating to 1.15% of Australia's gross domestic product or \$420 per person (Ramsey, 2003). The total cost of fire in the United States is a combination of the losses caused by fire and the money spent to prevent worse losses, by preventing fires, containing them, detecting them quickly, and suppressing them effectively. For 2004, that total cost was estimated at \$231-278 billion, or roughly 2 to 2.5% of United States gross domestic product (Ashe, McAneney & Pitman, 2008).

Property loss represents only \$11.7 billion of this total estimated cost of fire. The net costs of insurance coverage (\$16.2billion), the cost of fire departments (\$28.3 billion), building costs for fire protection (\$41.3 billion), other economic costs (\$38.5 billion), the monetary value of donated time from volunteer fire fighters (\$52-99 billion), and the estimated

monetary equivalent for the deaths and injuries due to fire (\$41.9 billion), all are larger components than property loss (Ashe, et al. 2008).

1.3 Significance of the Study

To address the issues raised by the demographic change within the fabric of society the Australian Government released the National Strategy for Ageing Australia in 2001. The strategy provided a framework to underpin the Government's leadership role in encouraging the development of appropriate economic and social policies. In 2005-06 the Australian Government's total expenditure on ageing and aged care was \$7.1 billion, 5.3 billion of which was paid for residential care subsidies equating to an average subsidy per utilised place of \$ 34,000.

In 2005 there were 183,395 allocated residential type places of which, 161,165 places were operational with the average age of the resident being 83.5 years. The average stay was almost 35 months, with 37% of people staying less than a year, and 20% staying more than 5 years (Department of Health and Ageing, 2006). Over 1,550 organisations deliver residential and community aged care services directly subsidised by the Australian Government. Religious and charitable organisations provide the majority of age care services, but providers can range from large religious providers and publicly limited companies through to small family run businesses and community based organisations.

Aged Care Facilities have to have their buildings assessed for certification of the facility. The building certification was introduced in 1999 in an attempt to improve the physical standard of aged care homes. Certification is a home review, which allows certified aged care facility operators to receive accommodation payments or receive concessional residential supplements from the Australian Government. To achieve certification, an aged care home is inspected to determine whether it meets certain minimum standards relating to fire safety, security, access, hazards, lighting, heating, cooling and ventilation.

While all homes have been assessed, certification is an ongoing process (Department of Health and Ageing, 2006). In 1999 a 10-year plan for certification was agreed with the aged care sector, which sets out minimum standards to enable providers to plan and implement improvements in accommodation. This plan comprise of main elements, being:

Certification assessment instrument, which come into effect on the 30th July 1999 and included a mandatory minimum fire safety score 19 out of 25 and an overall minimum pass mark of 60 out of 100.

Privacy and space standards for existing residential aged care buildings, which must be met by 2008. Set minimums of no more than four residents in any room, six residents per toilet and seven residents per shower (Aged Care Act, 1997 p.12).

Although certification included fire safety requirements, approved providers must also comply with all state, territory and local government law relating to fire safety. Approved providers must submit an annual fire safety declaration to the Department of Health and Ageing, to prove assurance that their homes have, for the last 12 months, complied with such laws (Department of Health and Ageing, 2006).

1.4 Research Question

The purpose of the study was to measure the compliance in maintenance of fire/smoke doors and compartmentation within an aged health care environment, posing the following research questions:

1. What is the measure to which fire doors and smoke doors are being maintained, when compared against the requirements defined under AS1851:2006 table 17.4.3.1 and table 17.4.4?
2. Does non-compliance with AS1851:2006 table 17.4.3.1 and table 17.4.4 increase the risk to residents in aged care facilities?

1.5 Literary Review

The literature review (Chapter 2), central to the study of risk management in the context of nursing home was considered with a focus on nursing home fires and factors affecting the nursing home environment, such as the changing demographics of the resident. Age trends, both in Australia and the United States of America, are considered while introducing increases in risk of fire within the nursing home perspective.

Risk perception considered from a cultural and social perspective is often a area which influences how we assess and react to risk levels. An understanding of the risk communication obstacle and strategies is a fundamental key to good communication techniques and the ability to overcome the perceived risk levels and impact.

1.6 Study Design and Methodology

The methodology (Chapter 3) adopted to support the assessment on compliance of fire and smoke doors maintenance examined the processes involved in the construction of the study from the sample size, auditing process, data collection and interpretation (see chapter 4) of the findings. The pilot study was undertaken as a template to allow implemented system and procedures to be integrated into a sustainable and reliable model for use in the main study and creating a repeatable process, allowing the study to be duplicated. The data collection was undertaken through an auditing process and considered as the research methodology for the study.

The maintenance compliance of fire and smoke doors was measured through a survey undertaken on the doors in 22 nursing homes within Western Australia. In the nursing homes there were a total of 52 fire doors and 108 smoke doors. The survey was conducted through the completion of Fire Safety Audit in line with the requirements defined in Australian Standard AS4655:2002, while measuring the compliance tables 17.4.3.1 and 17.4.4. from the Australian Standards 1851:2005, Maintenance of Fire Protective Systems and Equipment. The Class 9c facilities (Chapter 2) were categorised through assessment against the Building Code of Australia.

The study also considered face validity, concurrent validity and reliability to demonstrate the study's validity. The reliability of the study was established through the integrity of the study in the population size, consistency within the auditing process and the auditing tools and guidelines as well as being undertaken by a suitably qualified auditor. The ethical aspect of the study was of the upmost importance and concern due to the inherent dangers with the nature of the facilities environment. It was seen as imperative that the ethics guidelines were well covered and complied with.

1.7 Data Collection and Analysis

Raw data was undertaken by the auditing process (Chapter 4), allowing the data taken to be analysed and interpreted when assessed against the research questions to establish the study's findings. This approach identified the level of non-compliance in the maintenance of fire doors and smoke doors within Western Australian nursing homes.

Australian Standards 1851:2006 Maintenance of Fire Protective Systems and Equipment Section 17 tables 17.4.3.1 and 17.4.4 were used as the benchmark for the assessment of the doors (Annex A). The assessment dealt with the check list for maintenance of fire and smoke containment systems comprising hinged and pivoted fire doors and smoke doors.

1.8 Findings and Recommendation

The assessment of fire and smoke doors (Chapter 5), surveyed found that 87% of these doors were found to be non-compliant. The nature of the environment for the care of the elderly creates inherent problems such as mobility, self sufficiency, mental illness and disabilities, such as hearing and sight loss, which create high care environments. These fire and smoke doors failures created serious deficiencies with regards to the performance of the fire protection system. Social perception and expectation is those nursing homes are expected to care for the elderly and provide a safe and secure environment. The facility managers and owners have a duty of care, both legally under the Occupation and Health Act 1991 and morally.

1.9 Conclusion

This chapter gave an introductory overview of the study. The background of the study introduced the changes within the population demographic by 2055. The significance of the study identified impact these demographic changes would have on the aged care industry within Australia. The cost of aged care for the Australian Government was shown as a significant investment which will be impacted on greatly with the changing demographics. The literature review introduced the holistic overview of topics covered by the study supporting the background and substance for the study. The chapter also gave brief introduction in to the mechanics behind study the design and methodology applied within the study process for the collection and analysis of collected data. The collected data allowed for the findings to be examined and recommendations to be made.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter will present literature pertinent to the core body of knowledge within the study of risk management in a nursing home context. In addition, ancillary articles relating to nursing home fires, the environment within nursing homes and the demographic of the residents both in Australia and America are considered. The heightened risk within nursing homes with regards to the break out of fire will be considered, as well as social perception of the level of risk within a nursing home environment. The classifications of building and nursing home certification processes will be considered with regards to risk mitigation. There is an inextricable link between fire life safety and the function of security, with risk management considered to be a core knowledge category of security (Brooks, 2006). Nursing homes are historically perceived as places of security that care for dependant or infirm members of society. This chapter is finalised with a conclusion.

There is an inextricable link between the legislative and prescriptive guidelines for the accreditation of nursing homes to achieve 9c status and risk management within a nursing home environment. It can be seen that the legislative guidelines laid out in the Aged Care Act 1997, the Building Code of Australia and the Occupational Health and Safety Act 1991 are not mutually exclusive to the maintenances of the facility. The maintenance of all fire equipment is laid down within the makeup of the Australian Standard 1851:2005, a document created to allow compliance with the Building Code and OH&S Act and which relies heavily on guidelines for assessment laid down within Australian Standards 4655:2005 Fire Safety Auditing and 1905:2005 Fire Door construction. Figure 1 depicts the like between the management of risk within the nursing home environment and the legislative and prescriptive guidelines which help to mitigate the risk exposure found within that type of environment. In addition, the figure presents an overview of the literature review.



Figure 2.1 Risk Management within Aged Care

2.2 Aged Care

This section will consider the health patterns associated with a modern Australian society. It considers the impact of the changing demographics upon society, as well as assessing the effects that these changes may have on the demands placed on health care providers and the increase in the level of risk associated with the changes.

2.2.1 Australian Heath Patterns

Our dependency upon care facilities will continue to increase, associated with an increase in the number of people leading unhealthy life styles. The results from the 2004 to 2005 national health survey (Australian Bureau of Statistic, 2006) reported that a higher percentage of Australian adults were overweight or obese and more drank alcohol at risky or high risk levels than in 2001

In 2004 to 2005, 77% of the population reported that they had at least one long-term medical condition. Sight conditions, arthritis, hearing loss and high blood pressure were the most common conditions in age groups 65 years and over. The group had just under half (49%) who reported they had arthritis, 14% reported they had diabetes mellitus and 18% reported a heart, stroke or vascular disease (Australian Bureau of Statistics, 2006). Wooldridge's (2008) Australian Study into people living with psychotic illness between 1997 and 1998 found that high or very high levels of psychological distress were recorded for 13% of the adult population, similar to the levels recorded in 2001.

2.2.2 Aged Care in Australia

Within the next 20 years, the number of Australians who are 70 and over will grow at a rate 3.3 times faster than that of the total population. There were 2,503 people aged 100 or over at the last 2002 census, by 2055 there are likely to be around 78,000 people aged 100 years or more (Department of Health and Ageing, 2006). Roughly 25% of people over the age of 70 will utilise aged care resources of which 10% will receive attention in a care facility, while the remaining 15% will be provided with care in the family home falling into a category referred to by the Australian Government as community care (Australian Government, 2006). The growth in the ageing population over the next 50 years will result in 10% of the population being over the age of 80, equating to 2.9 million people (Department of Health and Ageing, 2006).

According to the Australian Department to Health and Ageing (2008), there are currently 2867 accredited aged care facilities within Australia offering 152,790 low and high care places. Extrapolation of the projected number of residents over the age of 80 years of age will necessitate an increase by 2055 to 19 times the level of today. The Australian Governments funding of aged care in 2005-06 was \$7.1 billion dollars (Australian Government, 2006). According to the Australian Bureau of Statistics (2008) the Australian Gross Domestic Product (GDP) in 2007 was \$857 million dollars. The projected cost to the Australian Government in the next 50 years, through straight extrapolation, could reach in

excess of \$135 billion dollars, equivalent to 16% of the current Australian Gross Domestic Product.

When comparing the demographic swing of the United States population it would appear to have moved in the same direction as that of Australia. In 1980, only 11.3 % of the U.S. resident population was 65 years old or more. By 2000, 12.4 % had reached that age bracket. The 65 or over age group is projected to increase to 13% and 16.3 % respectively of the population in 2010 and 2020 respectively (U.S. Census Bureau, 2003). According to Grassley (2007), the United States 1.5 million nursing home residents are a highly vulnerable population of elderly and disabled individuals that have necessitated the development and enforcement of fire safety standards for nursing homes. Many residents have restricted mobility that may be accompanied by cognitive impairments; conditions that can limit their ability to escape if a fire should occur. To ensure the health and safety of nursing home residents, the United States Federal Government adopted and enforces standards that all nursing homes have to comply with.

2.2.3 Fire Death Risks among Older Adults

The home fire death rate is higher for older adults than for any other segment of the population, increasing in-line with the advancement of older age (Hall, 2004). In 1995-1999, the risk of dying in a home fire was 2.2 times as high for those 65 and over as it was for the general population. For those 75 and over, the risk was 3.1 times as high and for those 85 and over, the risk was 4.5 times that of the general population. Although the percentage of people 65 and over who smoke is less than half of that of people aged between 18 to 64 years, 40% of individuals who died as a consequence of smoking related fires were at least 65 years of age (Hall, 2004a).

Other leading causes of home fire deaths among older adults are heating, cooking, and electrical distribution equipment. Intentionally set fires ranked fifth, nevertheless accounted for a much smaller share of the fire deaths for this age group than for those between 18 and 64 (Hall, 2004b).

2.2.4 Vulnerability Increases with Age

Normal physiological changes, as well as medical conditions, become more common with increasing age resulting in an older population that are more likely to have difficulties with hearing, vision, smell, mobility, memory, and decision-making than the general population. Among non-institutionalised adults, 29.7% aged between 65 to 74 and 46% of those 75 and over report at least a little hearing trouble. Among the 65 to 74 age group, 14.5% reported vision trouble which increased to 21.1 % for those at least 75 years. Mobility also becomes a greater concern with age, as 9.4% of those 65-74 find it very difficult or impossible to climb up ten steps without resting, increasing to 21% for those 75 years or older. Among people between 65 and 74, 16.8% report that it is very difficult or impossible to stoop, bend, or kneel, the percentage increased to 27.9% for those 75 or older (Lethbridge-Cejku, Schuller & Bernadel, 2004).

In 2000, 14.2% of the non-institutionalised United States residents who were at least 65 years of age had some type of sensory disability, 28.6% had a physical disability and 10.8% had a mental disability, including problems with learning, remembering or concentrating. In 2002, 23.6% of those 65-74 lived alone, while 65.1% lived with a spouse and 11.3% lived in care facilities. For those 75 and older, 39.6% lived alone 45.1% lived with a spouse and 15.3% lived in care facilities (United States Census Bureau, 2003).

Bruck (2001) found a relationship between sleep and waking to fire alarms. 25% of those over 60 years may be unlikely to wake to a 55 dBA alarm and 10% of those over 70 years may sleep through 75 dBA alarm, the required minimum audible level of a fire alarm at the bed head (Australasian Fire Authorities Council, 2006). This relationship was attributed to hearing loss of higher frequencies in older persons. In addition, those under the influence of sleep-inducing medication are unlikely to arouse to 75 dBA alarm and such medication is in high use among the elderly (Bruck, 2001). The Building Code of Australia states, "in a class 9c aged care building, the system must be arranged to provide a warning for occupants' and must notify staff caring for the residents of the building; and in areas used by residents, may have its alarm adjusted in volume and content to minimise trauma

consistent with the type and condition of residents” (2007, p. 261). The increased use of medication may dramatically increase the possibility of sleeping through an alarm.

2.2.5 Risk of Medical Oxygen

People with impaired respiratory systems, many of whom are older adults, use medical oxygen at home and within care institutions. Products such as furniture, mattresses and bedding have flammability requirements, which may be compromised when medical oxygen is in use. According to The National Fire Protection Association (2004) the use of medical oxygen in the home environment is a growing concern, which was confirmed in a review of fatal fires reported between 1997 and 1998 that found that 7% of the victims were smokers with medical oxygen.

Between March 1999 and November 2000, 12 oxygen-therapy fires in Philadelphia caused three deaths and injured seven others caused by smoking materials or the open flame used to light cigarettes (Garrity, 2000). In 2002, medical oxygen was a factor in four Massachusetts fire deaths, all caused by smoking (Massachusetts Department of Fire Services, 2004).

2.2.6 Staff and Patients

The nursing home population has been rising and with the increasing age of the population, it can be expected to grow substantially in coming years. Staffing patterns in nursing homes have also been changing, based on the type and location of the facility. In 1995, 54% of chain nursing homes had an average of 51.5 nursing employees including registered nurses, licensed practical nurses, aides and orderlies per 100 beds, while independent homes had 52.1 employees. By 1999, chain homes representing 60% of the market and had 42.8 staff per 100 beds, however independent homes had 69.5. Staff plays a role in any emergency situation in an institutional setting by closing doors, moving patients, etc., in the event of a fire (Garrity, 2000; Jones, 2000).

Other aspects of healthcare are also changing. In 1970, the average length of stay in U.S. short-stay hospitals was 7.8 days for all ages up to 65 years and 12.6 days for people 65 years and older. The average duration of stay in hospital in 2002 was reduced 37% to 4.9 days and reduced 55% to 5.8 days for patients within 65 years and over group. From 1970 to 2001, the number of discharges for the general population increased 12%, while discharges for those over 65 increased 112% (DeFrances & Hall, 2002; U.S. Centres for Disease Control and Prevention, 2004). This change in patient population has altered the assessment criteria from a fire risk management stance in that patient population has become older while staying in hospital shorter period of time; nevertheless, larger numbers of patients are likely to be sicker or in earlier stages of recovery and may therefore require more assistance to achieve mobility. In addition, nursing staff may have less experience with that particular patient. These factors could increase the time required in a fire evacuation.

2.2.7 The Cost of Fires in Australia

The total cost of fire in Australia has been estimated at approximately AUD\$8,500 million per annum or approximately 1.15% of the country's gross domestic product (GDP). This cost equates to an annual sum of approximately \$420 for each citizen. Comparable studies in the United Kingdom, United States, Canada and Denmark showed that the costs in these countries ranged from 0.9% to 2% of GDP (Ramsey, 2007).

2.2.8 Fires in Nursing Homes, Residential Board and Care Facilities

Between 1999 and 2002, an average 3,680 structure fires in nursing homes, residential board and care facilities were reported to the U.S. fire departments per year. These fires resulted in an annual average of 11 civilian fire deaths, 172 civilian fire injuries and \$12.5 million in direct property damage. Almost half (47%) of the reported fires were caused by cooking equipment or cooking activities. During the same four-year period an average of 3,150 structure fires were reported in other healthcare properties per year. These fires caused an annual average of one civilian death, 87 civilian injuries and \$25 million in direct property damage. The reason for the difference in death rates for the different

category of health care establishments is due to the additional fire safety requirements within hospitals and care facilities, such as suppression and detection systems (Gabrel & Jones, 2000).

2.2.9 Fire Detection and Suppression

Smoke detection and sprinklers are more common in health care properties than in most other occupancies. In 1999-2001 92% of health care facilities, except nursing homes, had smoke detection equipment, with 94% of nursing homes and residential board and care facilities similarly equipped. During that same period, detection equipment when present operated in 89% of the reported fires in healthcare properties and in 91% of the nursing home and residential board and care fires (Aherns, 2004).

2.3 Nursing Homes

This section will consider the nursing home environment from a holistic overview. It will start by examining the nursing home accreditation process and the principles behind its introduction by the Australian Government in 1997. A fundamental component of this process is the assessment of the home and the principles applied to the process.

2.3.1 Nursing Home Accreditation

In 1997 the Australian Government introduced Nursing Home Certification legislation incorporated within the Aged Care Act 1997. Its purpose was to seek to ensure that a minimum building standard was met by service providers who sought funding from the Australian Government for providing residential aged care services. The certification, although not a mandatory requirement under the Aged Care Act 1997, acts as a supplementary obligations to those currently laid down within the Australian State, Territory and local government laws relating to service levels.

The benefit of certification for residents is that the process aimed at improving the physical quality of residential aged care buildings to meet the demands of the growing aged care market, while providing an incentive and an income stream to support capital investment in

improving buildings. Services that achieve certification are able to access funding through resident payments of accommodation bonds and charges or to receive concessional support, as well as capital for upgrading and rebuilding of aged care services from the Australian Government (Australian Government, 2008). In addition, when considering whether a service is suitable for certification, the Department of Health and Ageing must consider, among other things, the standard of residential care being provided by the residential care service, the conduct of the approved provider and whether the provider has complied with their responsibilities and obligations under the Aged Care Act 1997.

The certification assessment process is conducted by a physical examination of all the buildings that form the service, against the Certification Assessment Instrument (CAI). The CIA is made up of seven sections covering safety, hazard analysis, privacy levels, access and mobility issues, heating and cooling, lighting and ventilation, and security. To achieve certification a mandatory requirement of 19/25 assessment is required for fire safety. The prescriptive levels set within the assessment instrument are based on the Building Code of Australia, as a minimum standard (Australian Government, 2006).

The Australian Government, in consultation with the aged care industry, introduced a ten-year forward plan for certification in July 1999, with the key objective of forward planning to improve fire safety in the medium-term, and privacy and space in the long term. In 2004, the Australian Government paid a one off payment of \$513 million, calculated at \$3,500 per care recipient specifically to improve fire safety. In 2005 the certification process identified 2940 Residential Aged Care Services throughout Australia, with around 300 (10%) yet to demonstrate meeting the required minimum fire safety standards set by the Department of Health and Ageing in 1999 (Aged Care Standards and Accreditation Agency, 2008).

Under the Aged Care Act 1997 the Secretary, in considering an application for certification, must have regard to the standard of the buildings and equipment that are being used by the residential care service in providing residential care, the standard of

residential care being provided by the residential care service and the provider's conduct as a provider. In addition its compliance with its responsibilities as a provider, its obligations arising from the receipt of payments from the Australian Government for providing aged care and other matters specified in the certification principles

In December 2003, the Australian Government introduced an annual Fire Safety Declaration process for all residential aged care services under the Aged Care Act 1997. Approved providers are required to submit the declaration to the Department of Health and Ageing by 31 March each year, indicating compliance and/or non-compliance with all State, Territory and local government laws in relation to fire safety. The declaration seeks assurance for the Australian Government that operators of residential aged care services are providing a quality and safe environment for residents and that all State, Territory and local government laws in relation to fire safety have been met (Australian Government, 2008).

As the Australian Government does not have responsibility for fire safety laws, all non-compliant declarations are referred to the relevant local Council (with the exception of the ACT, which are forwarded to the ACT Fire Brigade) for their information and possible follow-up action. A copy of each of the non-compliant declarations is also provided to the Aged Care Standards and Accreditation Agency (Australian Government, 2008).

2.3.2 Aged Care Standards and Accreditation Agency (ACSAA)

The Aged Care Standards and Accreditation Agency (ACSAA) is an independent company body appointed by the Secretary of the Department of Health and Aged as the accrediting body under the Aged Care Act 1997. The core function of the ACSAA is to manage the residential aged care accreditation process using the accreditation standard, while promoting higher quality of care and as liaison with the Department of Health and Ageing. Further assistance is given through the improvement of service quality by the identification of best practice and provision of education and training regimes (Aged Care Standards and Accreditation Agency, 2008).

2.3.3 Aged Care Funding

Annual funding of residential aged care by the Australian Government is \$5.3 billion (Department of Health and Ageing, 2006). Fees are also chargeable to residents, allowing fair contributions based on their ability to meet the payments. This daily living costs and accommodation contribution portrays the image of dependency and living in the community. Daily care fees are a contribution of the resident's daily living costs, such as nursing and personal care, meals, linen and laundry, as well as heating and air-conditioning. Residents who have assets above a level set at 2.5 times the 2006 basic aged pension amount of \$31,500 (Australian Government, 2008) may also be asked to pay an additional income-tested fee depending on their income and level of care.

Centrelink and the Department of Veterans Affairs conduct the assessment that determines the level of assets held by the resident and whether they are eligible for Government assistance with their accommodation. There are also protection mechanisms in the form of hardship provisions under the Age Care Act 1997 for residents who experience difficulties paying aged care fees. Between 16 to 40% of places, dependent upon the region, are reserved for such residents who receive additional Government funding to assist in meeting these cost (Australian Government, 1997).

According to figures released by the Department of Health and the Ageing (2008) there are different categories for payment amounts. The payment for residents in low-level care is generally in the form of an accommodation bond, which can be paid as a lump sum or a regular periodic payment or a combination of both. In 2004-2005 the average bond was \$127,618.00, held until the resident left the home or died. Payments for residents in high care are in the form of a daily accommodation charges, based on the level of assets held by the resident and can only be charged if their assets exceed 2.5 times the aged care pension (Australian Government, 2008).

2.4 The Building Code of Australia

This section considers the link between the Building Code of Australia and the nursing home accreditation process, as well as introducing the overarching legislative requirements for compliance with certain aspects of the Australian Standards, the Occupational Health and Safety Act and the Aged Care Act 1997.

The Building Code of Australia (BCA) is a document produced and maintained by the Australian Building Code Board (ABCB) on behalf of the Australian Government and each State and Territory Government. Legislative support is given to the BCA by the implementation of a legislative frame work passed by an Act of Parliament and subordinate legislation, empowering the regulation of certain aspects of buildings and structures. The ABCB's mission is to achieve community expectations of safety, health and amenity in design, construction and use of buildings throughout the nation (Building Code of Australia, 2007).

The BCA is described as a uniform set of technical provisions for the design and construction of buildings and other structures throughout Australia, while allowing for variations in climate and geographic conditions (Building Code of Australia, 2007). It also provides a descriptive overview of the class of buildings covered within the code, as well as the type of construction. Table 2.1 shows the buildings and as classified within the Building Code of Australia (2007):

Table 2.1

Australian Building Class's

Class	Building Type
Class 1a	a single dwelling being
Class 1b	a boarding house, guest house, hostel
Class 2	a building containing 2 or more sole-occupancy unit's as separate dwellings.
Class 3	residential building, which is a common place of long term or transient living for a number of unrelated persons.
Class 4	a dwelling in a building that is Class 5, 6, 7, 8, or 9
Class 5	an office building used for professional or for commercial purposes
Class 6	a shop or other building for the sale of goods by retail or the supply of services direct to the public.
Class 7a	a car park
Class 7b	a storage, or display of goods or produce for sale by wholesale
Class 8	a laboratory, or a building in which a handicraft or process for the production assembling, altering, repairing, packing, finishing, or cleaning of goods or produce
Class 9a	a health-care building
Class 9b	an assembly building, including a trade workshop, laboratory or the like in a primary or secondary school
Class 9c	an aged care building
Class 10	a non-habitable building or structure

(Adapted from Australian Building Code, 2007)

The ABCB comprises of Australian, State and Territory Government's principal officer responsible for building regulatory matter, representatives from the Australian Local Government Association (ALGA) and building and construction industry (Australian

Building Code Board, 2007). The Board is supported by the Building Codes Committee, the peak technical advisory body, consisting of the General Manager of the ABCB and one nominee from each of the Australian, State and Territory Governments, ALGA members of the ABCB, and representative of the building and construction industry (Australian Building Code Board, 2008).

2.4.1 BCA from a Risk Management Perspective

The Australian Building Code is a prescriptive guideline for the construction of buildings throughout Australia designed to manage risk by having minimum acceptable construction standards. The primary role of risk management is to reduce risk exposure through the management of risk. From a fire risk management stance, the benchmark level for fire safety to be achieved has been defined as one not significantly less than that of the Building Code of Australia.

There is no single level of risk that can be said to be acceptable. New buildings are generally taken as the benchmark, therefore arguably a building that falls within the distribution of likely outcome for new buildings can be considered acceptable, as threat is the level prescribed within the BCA (Sarantzouklis, 2005).

2.4.2 Australian Standards 1851 Maintenance of Fire Protection Systems and Equipment.

Australian Standard 1851 is designed to maximise the reliability, integrity, functionality and performance of fire protection systems and equipment to meet the requirements of the relevant design, installation and commissioning standards. Consideration has also been given to the interface between equipment for fire detection and fire fighting. The introduction to the standard states that these standards have been created to fulfil the requirements laid down in legislative form in the Occupational Health & Safety (OH&S) Act and Building Code, both of which are accompanied by relevant state legislation applying legal requirements (Standards Australia, 2005a).

The Occupational Health & Safety Act regulatory framework aims to eliminate risks to health and safety so far as is reasonably practicable by assigning general duty of care obligations to those who are in a position to control the generation of the risks. The general duties specify broad obligations to ensure the health and safety of employees, contractors and other persons present at, or near, a workplace (Australian Government, 1991).

The combination of inspection, test, preventative maintenance and surveys may demonstrate compliance with the maintenance requirement of the Building Code. The revised inspection, test, preventative maintenance and survey regimes in this standard address the functional aspects of installed fire protection systems and equipment on a periodic basis, with the objective that the systems and equipment operate effectively at all times. The regimes aim to ensure that the fire protection systems and equipment are in working order throughout the year or period of interest, not only at the time of annual inspections and tests (Building Code of Australia, 2007).

2.4.3 Australian Standard AS4655:2005 Fire Safety Audit

AS 4655:2005 is used to ensure that a systematic process for undertaking the required fire safety audits and scope of works process. A systematic process of understanding the fire safety audit and scope process is considered essential, given the independent third party requirements to sign off the compliance of undertaken works (Standards Australia, 2005b). Fire safety audits are generally characterised by reliance on a number of principles. These principles will make the fire safety audit process an effective and reliable tool to support the owner or occupier of the property. Adherence to these principles is a prerequisite for providing fire safety audit conclusions that are relevant and sufficient to enable all fire safety auditors working independently from one another to reach consistent conclusions (Sarantzouklis, 2005).

2.4.4 Australian Standards AS1905.1:2005 Fire Resistant Door Sets

AS 1905.1:2005 is a prescriptive guideline for the manufacture and installation of fire rated door sets. Through compliance with this standard a consistency is reached with regards to

the fire rated door construction and installation, which allow protection of openings in walls and partitions that are required to resist the passage of fire. This standard is also required to complement the requirements laid down within the Building Code of Australia and to be used with regards to the requirements laid down in Australian Standard AS1530.4: 2005 Fire resistant test in elements of building construction (Australian Standards, 2005c).

2.5 Safety and Security

This section will introduce the principles behind risk identification and management. In addition the socio-economic background that influence risk perception and the way decisions formed and communicated.

2.5.1 Risk

As defined in The Concise Oxford Dictionary, security is things that guard or guarantee safety of state, company, etc; against espionage, theft or other danger (Sykes, 2001). There are many identified definitions, with the Australian 4360:2004 considering risk as the chance of something happening that will have an impact upon objectives, measured in terms of consequence and likelihood (2004). Broder (1984, p. 1) limits the meaning of risk to “the uncertainty of financial loss, the variation between actual and expected results, or the probability that a loss has occurred or will occur”. Fay (1993, p. 163) considers “loss potential can be established by the analysis of threat and vulnerability. Reducing either the threat or the vulnerability and reducing the risk”.

Risk can be expressed in a number of ways, including economic or business loss, human health, (injury and/or fatality), environmental damage, corporate image as well as legal implication (Helmets, 1982). Most often for fire safety codes and standards, risk measures focus on eliminating or reducing risk through the use of risk management strategies such as the risk matrix process. The process of constructing a risk matrix:

begins with determining how the matrix is intended to be used. A decision needs to be made to define the risk acceptability criteria for the matrix

construction. Without adequate consideration of risk acceptability, a risk matrix can be developed that implies a level of risk acceptability much higher than required, along with the capability to evaluate the effectiveness of risk mitigation measures form the back bone of the risk matrix process. (Helmets, 1982, p. 6)

In order to fully understand the issues involved within the identification of risk from a fire engineering perspective, it is first necessary to consider what the protected assets are. Assets, as stated by Lock (2001, p. 78), “are any items of value and can be classified in to one of three asset groups namely, personnel, property and information”.

1. Personnel: considers that protection of staff is a moral and legal obligation of a company. To retain key staff and the knowledge they possess may be most important for a company. If staff become ill or leaves, it creates loss of productivity in having to replace them and their knowledge.
2. Property: is the protection of any property possessed by the company.
3. Information: with its value varying dependent upon the context in which it is presented and its relevance to the core business of the organisation. The value of each asset base is dependent upon several fluctuating variable, the value of the respective asset to the company is often assessed by individuals with a predetermined perception of risk and the effect of it on the organisation and the asset. The decisions made process made while assessing risk levels is often a reflection of one’s life experiences and the cultural and social position.

According to Robbins, Millet & Waters-Marsh (2004), individuals have different decision-making rationality, the process of making a decision usually occurs as a reaction to a problem. This reaction is the difference between the current state and desired state, and how to achieve the desired state and that perception is a process by which individuals organise and interpret their sensory impressions in order to give meaning to their

environment. These reactions are usually based on personal factors such as attitude, interests, experience and expectations, supported by Bayes theorem on how people calculate event probability using prior (historical data) and posterior (new data) information in personal decision-making (Denardo, 2002).

One may form a decision on where you park your car in the car park; why the decision is made is likely to be a heuristic risk assessment made using not only facts, but through thoughts and feelings. A person's perception of risk can also be defined with the psychometric theory of risk, which correlates the level of 'dread risk' (strong risk fear), against 'familiarity risk' (no risk fear), depicting individual risk attitudes and perceptions (Slovic, 1987). Both of these examples demonstrate the individual complexities associated in social risk perception, which will not only vary between cultures, nevertheless can further complicate the concept of effective risk communication.

There are many reasons why people perceive risks differently and make seemingly different decision regarding risk in similar setting, but involving different people. According to Sjoberg (2000), people do not make the same estimate when they rate the risk to themselves, their family or to people in general. Factors that are widely accepted that may influence how people react to risk include how familiar or unfamiliar the person is with the risk, whether some form of stigma or adverse emotional feeling is attached to the risk, the unknown, past history or experience, and finally, fear or dread of the risk.

Sjoberg (2000, p. 2), states that "of the three heuristics, representativeness asymmetry, availability, and anchoring, it was most often argued that availability is important for understanding risk perceptions". It would appear that as people receive increasingly more information regarding a risk, often their perception of the level of risk also increases. This increase is an important factor when considering risk communication. Marris, Langford, & O'Riordan, (1998, p. 635) as cited in Fischhoff and Slovic (1981) states how lay people and experts consider risks differently, stating that lay people and experts do not use the same definitions of riskiness when assessing risks. Experts focused on quantitative

assessments of likelihood and consequences, whereas the general public incorporated a number of additional qualitative dimensions such as dread, involuntariness, controllability, lack of knowledge to those exposed and catastrophic potential.

2.5.2 Cultural Risk

Cultural theory (Thompson, Ellis, and Wildavsky 1990) attempts to explain risk perception in terms of culture and social structure rather than by an individual's psychology and consists of two components. The first is the functionalist believe that adhering to specific social relationships generate a distinctive ways of looking at the world, referred to as cultural biases. The second component is the claim that there are only four viable ways of life, defined by the strength of the grid and group characteristics of the social relations: hierarchy (high-grid and high-group), egalitarianism (high-group but low-grid), individualism (low-group and low-grid), and fatalism (high-grid but low-group) (Marris, Langford, & O'Riordan, 1998). Arcuri (2007, p. 359) asserts that "risks are significantly shaped by culture and every person is brought up in a community of different beliefs".

In contrast to individual risk, social risk criteria express a limit on the maximum impact that a facility may have on society as a whole, rather than on particular individuals. Social risk may be expressed in several forms, the sum of the expected number of casualties from each hazard scenario times the frequency of each hazardous scenario to state the maximum expected number of casualties. Alternatively a value / impact analysis may be presented, such as the expected casualties per year times a payment for each casualty, based on an average court awarded for damages and other costs (National Fire Protection Association, 2004).

2.5.3 Risk Toleration

Understanding which risks are acceptable and which risks are not are fundamental to the risk management process. Risk management decisions are made while considering the importance of the assets within the organisation context. The more important the asset to the organisation the more consideration is needed to protecting the integrity of it.

According to Evensky, Harold, Katz and Deena (2004), risk tolerance is a term used to define the extent to which a person chooses to tolerate the risk experiencing. Tolerability does not mean acceptance, it refers to a willingness to live with a risk. These risks secure certain benefits, in the confidence that risk is being properly controlled. To tolerate a risk means not to regard it as negligible or something to ignore; moreover, as sometimes we need to keep under review and reduce still further if and as it can. However for risk to be “acceptable” means that for purposes of life or work, we are prepared to take it pretty well as it is (Rose, 2007). Technology such as nuclear power, for some, is perceived to be more risky than to others who see it as less risky, but why is this so? According to Sjoberg (2002, p. 751) “the reason people perceive a technology to be risky are due to several factors beyond actual accidents and fatalities rates”. The lack of experience and understanding of technology can provide fear or reservation when interacting with it or the way it is reported through the media, perpetuating a feeling of dread or reluctance to embrace new technologies. This perception can be influenced by the way information is communicated and that the correct framing of the message can moderate the perceived performance risk (Grewal, Gotlieb and Marmorstein, 1994; Western, Burton & Kowalski, 2006).

2.5.4 Risk Communication

One of the fundamental dilemmas facing a healthcare facility manager is to be able to achieve a sufficient level of organisational support and an adequate budget to enable these recommended risk countermeasures to be implemented. Cole (2003) and Sennewald (2003) discuss that many employees and executives have a very limited view of what the safety and security function and therefore risk, actually consists of and propose that it is a tactical managerial error to not realise the contribution of risk management within an organisation. The lack of understanding that security does not impede the process of conducting business, but it actually facilitates and contributes in all areas of the business to the overall success. There are various factors which can contribute to the perception of security not benefiting an organisation and these may be difficult hurdles to overcome. One basic barrier is communication, being able to successfully sell your justification of

countermeasure strategies to the people who are the decision-makers and can implement them (Cole, 2003).

According to Peters, Richard, Covello, Vincent and McCallum, (1997) trust and credibility are the foundations of effective risk communication. Furthermore they hypothesised that these foundations are based on three determinants knowledge and expertise, openness and honesty, and concern and care. More recent studies by Haspersen, Golding and Tuler (cited in Peters, et al, 1997) identified four components of trust they included commitment to a goal and fulfilling fiduciary responsibilities, competence, caring, and predictability. Covello and Merkhofer (1993) asserts the caring and empathy, dedication and commitment, competency and expertise, and, honesty and openness in the way messages are communicated are all contributing factors that people use to determine trust and credibility. Positively framed messages emphasise the potential advantages or gains, and negatively framed messages communicate the potential losses or disadvantages (Grewal, et al. 1994). Owners of nursing homes advertise facilities in a positive frame with regards to the security and safe environment to make their facility attractive to potential customers.

Kahnemann & Tversky (1979) prospect theory (cited in Western Burton & Kowalski, 2006), predicts that people are more likely to take a risk to avoid a loss, than to obtain a gain. The gain could potentially be a more secure environment, provided the countermeasures are implemented. The implication of this theory, if applied by the nursing home manager, would be to communicate a loss as the potential negative consequences of not implementing the countermeasures. An example of this could be the cost-benefit ratio, which refers to the proportionate cost of setting up and maintaining a countermeasure compared to probable cost of the losses without it (Healy, 1984). This, together with the appropriate credibility of the message source, could be a great influential message packaging in effectively communicating the security and risk management program, by guiding the receiver's perception of the risk information given (Grewal, et al. 1994).

It is apparent that different entities communicate risk in different ways. That is, governments communicate risk differently in contrast to corporation and individuals. According to Chess (2001), when risk communication is a societal expectation, companies are more likely to be affected by institutional forces, such as guidance from trade associations, expectations of peers, and models of success. The nursing home environmental governance is imperative in creating a safe environment with a significantly reduced level of risk exposure. The stringent legislative requirements through the Aged Care Act 1997 and Occupational Health & Safety Act 1991 placed on the nursing home owners and managers overcome risk communication breakdown, removing some of the ambiguity involved with non-legislative guidelines such as Australian Standards.

Once an understanding of how and why an individual's risk perception might influence the effective implementation of risk countermeasures, the message then needs disseminating appropriately to the receiver. It is important, according to Evans (1984), to know your subject, know your audience and be able to 'close the deal' where possible in the necessary circumstances. With a clear understanding and acceptance of the level of risk systems and procedure can be considered to mitigate the risk through risk management strategies.

2.5.5 Risk Management

On establishing the influencing factor associated with risk, the management of the risk levels can be more effectively identified and treated from a holistic platform. At a basic level the word *Risk* is defined as the chance of something adverse will happen (Standards Australia, 2004). More strictly, this may mean the probability that a specified undesirable event will occur in a specified period or as the result of a specified situation (Blade, 2001). Therefore, risk is defined as the combination of likelihood of occurrence and severity of consequences. Risk management comprises an estimation of the risk, deciding whether or not it is acceptable and exercising appropriate measures to reduce the risk to an acceptable level (Covello & Merkhoer, 1993).

2.5.6 Fire Risk Management

Traditionally, fire safety design has been highly reliant on prescriptive rules in building and fire codes and standards, in particular relating to the minimum level of occupant safety in the case of fire. Although these prescriptive regulations are easy to use and the safety objectives are implicitly embodied in the prescribed values, they are somewhat inflexible, especially in non-standard situations. Prescriptive regulations are typically suited to generic uses or applications, for which they were initially derived and can be a barrier to innovation. If specific buildings, facilities, activities, etc., do not fit into the generic definition, the regulations may force users to incorporate too many or inappropriate fire safety measures or may even lead to safety levels that are insufficient (Frantzich & Hakan, 1998).

To remedy some of the prescriptive regulation deficiencies within the Building Code, more performance-based regulations are being developed. Performance-based regulations define the goals and objectives for a particular regulation; however, do not state how the objectives should be achieved. This performance approach leaves the decision up to the user on how best to comply with the objectives of the regulation. Although this allows the user greater flexibility in design, there are often no commonly accepted design landmarks (i.e. the response and behaviour time for people escaping from a fire), which makes compliance with acceptable life safety requirements difficult to measure (Frantzich, 1998).

2.6 Conclusion

This chapter considered the change in demographic within Australia, its impact upon the health care industry over the next 50 years and the financial pressures associated with the increase in the number of people over the age of 80 reaching 10%. The health trends with the onset of old age were also considered and identified several areas of impact; such as 46% of the population over the age of 75 having a reduction in hearing, 14.5% reported vision loss, with 21% of people over the age of 75 experiencing restricted mobility or the need for assisted mobility. The reduction in mobility and the loss of hearing impacts

substantially on the ability of the facility to be evacuated in the event of an emergency, such as a fire.

The combination of the health issues due to ageing, the patient population increasing in age, the reduction in time spent within healthcare facilities by patients, reduced familiarity of the staff with the patients showed an increase in the assistance required by patients in the evacuation of the facility.

The cost of fire within an aged care facility can be calculated not only from a property damage perspective, but also from the incidental cost associated with a fire such as the effect on branding of the nursing home owners. The cost in litigation, temporary repairs and total replacement all reflect the impact of a fire within a nursing home facility and highlights the needs to be considered when balancing risk against management of the risk.

Nursing homes that fall within the 9c category have to comply with the legislative requirements laid down within the Aged Care Act 1997. The requirements are that the nursing homes be assessed and accredited to hold the 9c status. This status allows subsidies to be obtained from the Federal Government of up to \$3,500 per aged care recipient to assist with the cost of upkeep of the residents, covering such costs as accommodation, heating and lighting. The fire safety assessment portion of the assessment process is a mandatory pass component in which the facility needs to reach a minimum score of 19 out of 25 points, with the overall assessment process carrying a maximum 100 points. The implementation of this measure should reflect the importance that fire safety has within facilities that care for the aged.

The Building Code of Australia 2007 was examined to establish the legislative framework supporting its creation and implementation. The correlation between the Building Code and the Australian Standards showed the base-line data for the construction of Australian Standards 1851:2005 Maintenance of fire protection systems and equipment, AS4655:2005 Fire safety audit and AS1905:2005 Fire rated door sets were taken from the Building Code

2007. Each standard complement the ethos running through the code, aligning its goals with the prescriptive guide laid down within the standards creating a more robust and holistic package.

This chapter explored theories behind the way people perceive risks and why they make certain judgments regarding risk. It considered cultural theory and other influencing factors that frames people's decisions-making and which governed the grid and group category people belong to. Psychometric paradigm was argued to grade perception of risk into risk perception, risk acceptance, and risk probability. There is no all encompassing theory that can adequately explain how people perceive and make judgments and decisions regarding risk. Therefore, it is a matter of choice or personal preference as to which theory is accepted and this decision will no doubt be determined by the setting and circumstance the risk assessor finds themselves in. The perception of risk by facility managers and owners has to be overcome for a full understanding of risk exposure within the nursing home environment.

Without the full appreciation of the level of risk and factors that frame the risk level it can be argued that the owners and facility managers may not embrace risk management strategies. Education and comprehension of risk assessment strategies and effective communication of risk is essential for risk understanding and compliance: there have been no traceable studies within this category previously undertaken.

CHAPTER 3

MATERIALS & METHODOLOGY

3.1 Introduction

This chapter presents the study methodology adopted to support the study, namely the compliance of servicing fire and smoke doors. The study design examined the processes involved in the construction of the study from the sample size, auditing process, data collection and interpretation of the findings. The pilot study is considered as a template, which through the implemented system and procedures adopted to create a sustainable and reliable model for use in the main study. The auditing process is examined and considered as the underlying research methodology for the study. These aspects are all considered critical to create a repeatable process, allowing the study to be duplicated.

This chapter also examined face validity and concurrent validity and reliability to demonstrate the studies validity, while strengthening the integrity of the study. The reliability measures are examined in the population size, consistency within the auditing process, the use of the same auditing tools and guidelines, and the audit being undertaken by a suitably qualified auditor. A fundamental issue was the ethics behind the research. Due to the nature of the environment in which the study was undertaken and the potential impact on the facility management or owners, it was seen as imperative that the ethics guidelines were well covered and complaint. The population sample and it's relevance to the study was also considered within the design of the study to establish the reliability of the audit findings. The chapter is summarised within the conclusion.

3.2 Study Design

The aim of this project was to measure the compliance of fire and smoke doors within nursing homes in Perth, Western Australia, against Australian Standards 1851.17:2006 Maintenance of Fire Protection Systems and Equipment. Therefore, it was decided for the purpose of this research project that a quantitative approach would be appropriate to gather the study data. This approach would allow a numerical value to be laid against the

compliance levels within the selected population and to have a subjective assessment made by the auditor as to the status of the surveyed item. This type of procedure allowed for a systematic assessment to be undertaken in order to provide factual and accurate findings. The structure of the study constituted the following stages, identified in Figure 3.1.

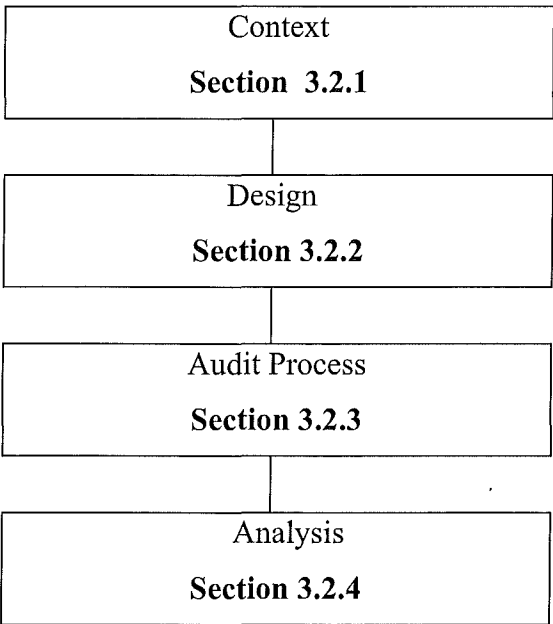


Figure 3.1 Study results procedures
(Adjusted from Gurdon, 2007)

The study was concluded by analysis of the data to establish the compliance levels found with regards to maintenance of fire and smoke doors in nursing homes in Western Australia. From the results, conclusions were draw with assumptions made into the levels of non-compliance and the reasons for the identified levels.

3.2.1 Context

The study examined compliance of standard fire and smoke doors by auditing. The auditing was undertaken by the assessment of compliance against AS 1851: 2005 Maintenance of Fire Protection Systems and Equipment and the check list used to identify faults on the doors were taken from Tables 17.4.3.1 and 17.4.4. This auditing process allowed context to be established for the study, setting achievable research objectives that could rigorously examine the research questions.

There are three basic research paradigms; positivism (quantitative, scientific approach), critical science and interpretivism (Cantrell, n.d). Positivism or quantitative approach is stated by Burns and Grove (2001) as a formal, objective, systematic process in which numerical data are utilised to obtain information about the world. Critical science explores the social world, critiques it and seeks to empower the individual to overcome problems in the social world. According to Bogdan and Biklen (1992), critical science enables people to understand how society functions and methods by which unsatisfactory aspects can be changed. Interpretivism, or the qualitative approach, is a way to gain insights through discovering meanings by improving our comprehension of the whole. It explores the richness, depth, and complexity of phenomena and broadly defined, as any kind of research that produces findings not arrived at by means of statistical procedures or other means of quantification (Strauss & Corbin, 1990). The study used a positivism paradigm to define the context. It allowed a quantitative approach to be adopted with the aid of scientifically based assessment. The auditing sheet has been designed through the assessment of the fire and smoke doors performance in the event of fire.

3.2.2 Design

The study design focused on the check list from AS 1851: 2005 Maintenance of Fire Protection Systems and Equipment tables 17.4.3.1 and 17.4.4, which consisted of 38 compliance items.

Unlike quantitative research, there is no overarching framework for how qualitative research should be conducted, as “each type of qualitative research is guided by particular philosophical stances that are taken in relation by the research to each phenomenon” (Denzin & Lincoln, 1994, p. 9). Therefore, the study adopted a quantitative approach for the research platform. As Burns and Grove (2001) stated, it allowed formal, objective platform to be adopted which through the aid of the study design and audit process produced a comprehensive overview allowing pertinent information to be retrieved.

3.2.3 Auditing Process

The auditing process was conducted through the completion of the designed audit sheet. The sheet was taken from the requirements identified within the AS1851:2005, which identified the key area of assessment on each door (see Table 3.1)

Table 3.1
AS1851:2005 table 17.4.3.1 and surveyed fire doors

SERVICE	OK	A	X	No defective
DETAILS				door leafs
CLEARANCE				-
LOCKSET I.D. Mark				-
Operation				-
Fixings				-

(Adapted from Australian Standards, 1851:2005)

Within the context of the auditing process the auditing check list has three possible outcomes the *OK* represents the door being in good working order. *A* signifies that a small adjustment was made at the time of the audit and *X* signifies that remedial works are required and will be reported upon.

3.2.4 Pilot Study

A pilot study was undertaken to evaluate the reliability of the checklist, the auditing process and the study design. A total of three nursing homes were examined during the pilot study. The pilot study nursing homes that were chosen had recent audits undertaken by a fire engineering auditing company located in the Eastern States of Australia, during which they examined in some depth the fire doors. These findings were used as a control sample and were not seen by the auditor prior to undertaking the audit. Although the sample was quite small, at 5% of the total study group, undertaking the pilot study allowed the auditing process to be checked for robustness and continuity. The three homes audited were owned and managed by different aged care organisations.

The pilot study results indicated that a degree of consistency was achieved with the result and that although the owners and managers were from different organisations, the findings were compatible with each other. The reliability of the sample was established through the combination of three key performance indicators. The first key performance indicator was the experience of the auditor, giving a consistent benchmark level throughout the whole auditing process. As specified within the guidelines for fire safety auditing for buildings, that a “person carrying out the fire safety audit needs to possess relevant qualifications or competencies appropriate to the auditing task” (Australian Standard, 4655, 2005, p. 11). The second key performance indicator was the comprehensive nature of the auditing tool, which followed the guidelines laid down within the Australian Standard 1851 Table 17.4.3.1 and 17.4.4 The final key performance indicator was undertaking of a comparison check against recently undertaken independent audit conducted by an Eastern States auditing company and used as a control sample.

3.2.5 Pilot Study Analysis

On completion of the pilot study audit the results from the audit and the audit undertaken by the Eastern States auditing company were compared to assess the accuracy of the check list designed for this study. The results showed two shortfalls within the check list, one in the area of fire door hinge identification and the second in vision panel construction details

with regards to permissible size and location. The degree of compliance found within the pilot study was 75% non-compliance, which gave substance that the research questions were relevance to the study. This result supported the progression of the research onto the main study.

3.3 Validity and Reliability

This section considers the validity of the study by cross sampling and subsequent results and the reliability of the findings through examination.

3.3.1 Validity

Spiker and McCandellless (1954) consider that there are categories into which the validity of studies are divided: predictive validity, concurrent validity, content validity and construct validity. The first two of these may be considered together as criterion-oriented validation procedures. The pattern of a criterion-oriented study is primarily interested in a criterion, which is to be predicted. The test is administered to obtain an independent criterion measure on a subject and compute a correlation. If the criterion is obtained some time after the test is given, predictive validity is being studied. If the test score and criterion score are determined at essentially the same time, concurrent validity is being studied.

Due to the nature of this study, it was considered that both face validity and concurrent validity would be considered to establish the validity of the study. Fink, Ward and Smith (1996) refers to face validity as being concerned with how a measure or procedure appears. Does it seem like a reasonable way to gain the information that the researchers are attempting to obtain? Does it seem well designed? Does it seem as though it will work reliably? Child (1954) considers face validity as the extent to which the contents of a test or procedure look like they are measuring what they are supposed to measure.

Concurrent validity is studied when one test is proposed as a substitute for another or a test is shown to correlate with some contemporary criterion (Carmines & Zeller, 1991). The AS 1851:2005 check lists has a strong correlation with the identified items within tables

17.4.3.1 and 17.4.4 and fell into this validity model (Appendix A). AS1851:2005 are considered the benchmark for maintenance of fire and smoke doors. Its status is derived from the standard being created to fulfil the requirements of the manufacturers to maintain the function of the doors to the level they were originally designed and installed too. As well as fulfilling the requirements of the Building Code and the Occupational Health and Safety Act 1991.

The validity of the data collection was addressed through the cross sampling of the auditing results. It can be proposed that cross checking data from multiple sources can help provide a multidimensional profile of composing activities in a particular setting. Merriam (1985, p. 12) stated that "checking, verifying, testing, probing, and confirming collected data as you go, arguing that this process will follow in a funnel-like design resulting in less data gathering in later phases of the study along with a congruent increase in analysis checking, verifying and confirming."

3.3.2 Reliability

Reliability refers to whether the data collection process measures what it is supposed to measure, the degree to which the data collection process covers the entire scope of the content it is supposed to cover, whether or not the data collection process is appropriate for the people to whom it will be administered and the consistency with which the data collection process measures whatever it measures (Carmines & Zeller 1997). Child (1958) refers to reliability as the measurement of how consistently an instrument accomplishes its intended purpose. The auditing process conducted within this study used data collection in the form of the check list, which addressed items specified in the Australian Standard 1851 2005 Section 17 pertinent to the tables 17.4.3.1 and table 17.4.4. These tables which provided a fully comprehensive overview of the items, examined and resulted in the survey data.

Part of the reliability process is the ability of the auditing process to be reproduced over and over, while maintaining the auditing processes integrity and consistency. The transferability of the audit is of the utmost importance to allow consistency of approach. Transferability refers to the possibility that what was found in one context by a piece of qualitative research is applicable to another context. As Lincoln and Guba (1985, p. 298) point out:

if there is to be transferability, the burden of proof lies less with the original investigator than with the person seeking to make an application elsewhere. The inquirer cannot know the sites to which transferability might be sought, but the appliers can and do.... The responsibility of the original investigator ends in providing sufficient descriptive data to make such similarity judgements possible.

The implementation of guidelines for the audit process designed around AS4655:2005 Guidelines for Fire Safety Auditing for buildings and the Australian Building Code Boards Fire Safety Engineering Guidelines created a scope of content appropriate to the data collection process. In addition, the persons undertaking the audit and administering the process, together with the consistency this provided, created a reliable and robust model which could be used by any suitably qualified person at any nursing home to assess fire and smoke door compliance. Through the data collection process, a uniformity of consistency was reached through the use of a robust and consistent surveying instrument and allowed the continued reproduction of the auditing process at a consistent level.

3.4 Ethics

The information pertaining to the location, organisations or persons involved within the auditing process, as well as the owners, facility managers and nursing home details were not released or identifiable. The auditing company's owners gave total and unrestricted access to the auditing information, with the expressed and unwavering requirement for anonymity to be kept throughout the process. The information obtained from the audit

process had all the identification markings removed to give total anonymity to the parties involved. The records of the audits were destroyed after the study's completion to prevent release of inappropriate information.

The information found within the audit was forwarded in the form of a report to the owners or managers of the nursing homes. These reports are often released to other service providers by the sites owners and managers, often to try to obtain alternative quotations for works based upon the report. Nevertheless, this approach was seen as being the prerogative of the owners or managers and often has to be undertaken to comply with their respective procurement guidelines. To maintain the integrity and security of the audit record these records were stored within a secure environment in a locked cabinet accessible, only by the senior management of the auditing company.

3.5 Population Sample

The sample size pertinent to this study had to be chosen to achieve a statistically appropriate sample size in an attempt to make the findings representative of the nursing home environment within Western Australia. Johnson (1959, p 167) asserts that:

in general, the sample size decision must be made on a case-by-case basis, considering the variety of goals to be achieved by a particular study and taking into account numerous other aspects of the research design. The size of a sample depends upon the basic characteristics of the population. If there is complete homogeneity, a sample size of 1 would be sufficient, while a larger sample is obviously required where the required characteristics display wide heterogeneity.

There are 252 accredited nursing homes in Western Australia, with 12,870 residential places of which 8708 are high care and 4162 low care residential places (Department of Aged Care, 2008). The sample population for the study was 22 nursing homes, which equated to 8.7% of the total nursing home within the 9c class. The size of the sample gives a relatively small overview of the Western Australian nursing home market. The size

sample was validated by the requirement for each of the 252 nursing homes to be accredited. Through the accreditation process the homes must demonstrate, through an on-site building inspection, that it's building achieve specified quality measures. The audits are inspected under the 1999 Certification Assessment Instrument (Department of Aged Care 2008).

Certification Assessment Instrument Section 1, which is a Fire Safety Assessment, must return a score of at least 19 out of 25 to obtain a pass. The implementation of this accreditation process and certification of the home gives a high degree of parity across the nursing homes. It allows an accretion to be made that a relatively small population sample produces a small sampling error and high confidence level. Borg and Gall, (1979, p 195; cited in Cohen, Lawrence and Morrison, 2000, p. 94) stated that:

as a general rule, sample size should be large where, there has a high degree of reliability and, only small difference or small relationship are expected or predicted, the sample will be broken down into sub-groups, the sample is heterogeneous in terms of the variable under study, reliable measures of the dependent variable are unknown.

Chisnall (1986) indicated that it is frequently a matter of concern as to the size of a sample drawn and the notion is that if the sample size is not large enough, the sampling results are likely to be inaccurate. It is sometimes presumed that a sample should be based on some agreed percentage of the population from which it is taken. Fowler (1984) assets the view that there is a constant percentage, often thought to be around 10 per cent, which can be applied when sampling populations of all kinds and sizes, is quite wrong and that researchers base the sample size on the margin of error that can be tolerated or the precision required of estimates. The results obtained within the pilot study were found to be robust encompassing an appropriately sizes sample which returned valid results for the used population.

3.6 Conclusion

This chapter presented the robust nature of the materials and methodology supporting the study. It considered the context into which the study could be placed and from that allowed the design for the auditing process to be formed. The appropriateness and validity of the pilot study size ascertained the confidence level of the process. On consideration of the findings of the auditing process, validity and reliability had to be established. This was performed by justification of a relatively audit small sample size against the prerequisite for high care and nursing homes to have independent assessment undertaken in order to obtain certification and accreditation as a 9c service provider. The accreditation process increased the confidence level of the auditing process through its requirement to have Fire Safety assessed as a primary auditing landmark.

CHAPTER 4

DATA COLLECTION, ANALYSIS AND INTERPRETATION

4.1 Introduction

This chapter considers the collected data analysed through the auditing process, followed by data interpretation. As part of the interpretation, the data was set against the research questions to relate the study findings. This approach provided an insight into the level of compliance in the maintenance of fire doors and smoke doors within Western Australian nursing homes. Australian Standards 1851:2006 Maintenance of Fire Protective Systems and Equipment Section 17 tables 17.4.3.1 and 17.4.4 was the benchmark used for the assessment. Assessment dealt with the requirements for maintenance of passive fire and smoke containment systems, comprising hinged and pivoted fire doors and smoke doors. Finally the chapter is summarised by a conclusion.

4.2 Auditing Process

The audit was under taken by a suitably qualified auditor who for the last 30 years had been involved in the manufacture, installation and auditing of fire and smoke doors. The process of auditing, through the use of the Australian Standards 4655:2002 Fire Safety Auditing Guidelines, gave a consistency to the process, allowing repeatability at each nursing home visited. This consistency was enhanced by using the same auditor for each audit and the completion of the same auditing check list (Appendix A). The time line for the auditing process was three weeks from the date of commencement to production of the raw data.

The sample size for the study was 22 nursing homes. There are 252 accredited nursing homes in Western Australia, offering a combination of high and low care (Department of Aged Care, 2008). The sample population equated to 8.7% of the total nursing home within the 9c class. The premises visited ranged in age from 25 years through to 3 years of age. The difficulty with a variation in age of 22 years is the standards to which the buildings were originally constructed and consideration of any variation in usage over that period.

The requirements of the building code in 1983 differed from today's building code due, in part, to the advancement in new construction methodology and products.

A secondary consideration was that the building code is an evolving document which is amended and released on an annual basis, taking into consideration best practice guidelines. Other considerations would be that some older nursing homes may have been upgraded and have their building usage changed. Any change of usage needs to be authorised by the regulatory authority and subsequently approved by them (The Local Government (Miscellaneous Provisions) Act, 1960; Building Regulations, 1989).

4.3 Study Analysis

The number of doors physically examined within this study totalled 160. Fire doors accounted for 52 doors and smoke doors 108. The auditing process was undertaken through the use of an audit spreadsheet adapted from the checklist embedded within the Australian Standard 1851:2005 table 17.4.3.1 and 17.4.4, which had a total number of 51 items to be checked against the door (Appendix A).

Of the 51 items checked on the 160 fire and smoke doors a total of 934 faults were found. This finding equated to an average of 6 faults per door, with a gives brief summary of the type and quantity of fault found on the doors (Table 4.1).

Table 4.1
Auditing Spreadsheet

SERVICE DETAILS	OK	A	X	No defective door leafs
CLEARANCE				98
LOCKSET I.D.				0
Mark				
Operation				19
Fixings				17
DOOR CLOSER				00
I.D.				
Operation				22
Fixings				00
SELECTOR				41
HEAD				61
LATCHING				
HINGES				03
I.D.Mark				
Operation				15
Fixings				5
DOOR				107
LEAF:TAG				
Panel Integrity				51

(Adapted from Australian Standard, 1851:2005)

In eighty seven percent of the fire doors and smoke doors surveyed (140 out of 160 door leafs) the doors were found to be non-compliant; many cases with multiple non-compliance issues. In total, there were 935 non-compliance failures on the 160 doors. The results from each audit were assessed individually by recording the number of doors audited and the number of non-compliant items found within the audit sample. The result was to produce an overview in the level of compliance of fire and smoke door maintenance in Western Australian aged care facilities. The collection and analysis of the results in this manor allowed for the presentation of the results as a quantitative value, allowing for a total percentage non-compliance to be reached.

During the course of the auditing process, faults were identified on the doors. The auditing process has no objectivity to cater for changes in use of the building. In addition it assesses

the asset to the level the door was originally installed at not, to the current application of the building. One failing within this type of system is that items such as the smoke doors have, since the publication of Australian Standard 1851:2005, only been incorporated within the maintenance regime. This created an extensive period of time, in some cases, from the installation of the door to the date of the requirement for the door to be maintained. During this period, carpets may have been changed, glassing may have been changed and larger vision panels may have been installed, all of which effect the performance of the door in the event of fire. To have to maintain the doors to a prescribed level required an understanding of the need for maintenance and a financial requirement, which may not be available in the current financial budget.

The collected data and its validity and reliability was obtained through the constancy within the auditing process, as well as the auditors industry experience. The check list sent a continuity monitor in place causing the auditor to adopt the same inspection rationale on each inspection as all sections of the sheet were completed.

4.4 Study Interpretation

The significance of this study was to achieve an understanding of AS1851:2006 table 17.4.3.1 and table 17.4.4 compliance in aged care facilities and the effect of non-compliance on the risk exposure within the facility. The survey data were analysed, with interpretation resulting in a number of significant findings. These include the measure of compliance to AS 1851:2006 Maintenance of Fire Protective Systems and Equipment tables 17.4.3.1 and 17.4.4. The findings allowed the research questions to be addressed and assumptions made regarding the current fire industry and maintenance compliance within the context of the study.

4.4.1 Research Question 1: Fire Door Compliance

Research Question 1 asked: *What is the measure to which fire doors and smoke doors are being maintained, when compared against the requirements defined under AS1851:2005 table 17.4.3.1 and table 17.4.4?* The audit process showed that 87% of the fire and smoke

doors were found to be non-compliant. There were a total of 51 items checked on the doors such as the identification on the door hinge being clearly legible which equated to 23 overall non-complacencies.

One of the largest areas of faults was found in the clearances around the fire door in relation to its position to the fire door frame. Australian Standards, 1905:2005 states that the clearance at the head of the door, the lock side of the door and the hinge side of the door cannot exceed 3mm and that the underside of the door cannot exceed 10mm. Of the doors checked, 124 of them were found to have excessive clearances-impacting on their performance in the event of a fire.

The defects are in breach of the legislative requirements within the Building Code of Australia 2005, although the argument could be used that the legislative requirement is not retrospective. The legislation with the highest degree of potential non-compliance is the Occupational Health and Safety Act 1991, which legislates that it is incumbent upon employers and employees to provide safe environments for working, which includes the environment within a nursing home. This significant non-compliance leads to a failure to maintain life safety critical assets, in breach of the requirements under the Occupational Health and Safety Act 1991.

The building certification for aged care facilities was introduced in 1999 in an attempt to improve the physical standard of aged care homes. The homes were then certified if they reached the required pass mark, allowing for high care residents to be allowed to reside at the home. To achieve certification, the aged care home is inspected to determine whether it meets certain minimum standards relating to fire safety, security, access, hazards, lighting, heating, cooling and ventilation. However, within the context of the study non-compliance still appears high.

While all homes have been assessed, certification is an ongoing process. The 10 year plan introduced by the Australian Government in 1999 for certification was agreed with the aged care sector, which sets out minimum standards to enable providers to plan and

implement improvements in accommodation. One of the main elements, the certification assessment instrument, which came into effect on 30th July 1999 is a mandatory minimum fire safety score of 19 out of 25 and an overall minimum pass mark of 60 out of 100 (Aged Care Act, 1997). Although there is no predefined mark attributed to fire doors the homes overall fire safety is assessed from egress routes through to maintenance of critical equipment such as fire detection systems.

4.4.2 Research Question 2: Risk Exposure through Non-compliance

Research Question 2 asked: *Does non-compliance with AS1851:2005 table 17.4.3.1 and table 17.4.4 increase the risk to residents in aged care facilities?* The findings of the study highlighted serious deficiencies within the maintenance regime of the nursing homes. The identified defect would result, in the event of a fire, with the fire and smoke doors not performing to the level they were originally designed. This failure could have an affect of letting either fire or smoke to pass the fire barrier, effecting the fire compartmentation and residencies evacuation times. The dependence of residents on assistance makes the evacuation processes a difficult and lengthy one, as time becomes the major factor for life preservation. A reduction in smoke and fire containment due to failure of fire and smoke doors or compartmentation becomes a serious risk to life and property.

The nature of the environment for the care of the elderly creates inherent problems such as mobility, self sufficiency, mental illness and disabilities, such as hearing and sight loss, which create high care environments. The increase in nursing home dependency by the community over the next 50 years will add to an environment struggling to meet demands (Department and Health and Ageing 2007).

From a risk management perspective, the identified non-compliance issues create an increase in the risk exposure level to residents within the care home. The increased time required to evacuate elderly people, combined with the reduced performances of the doors requires additional risk mitigation strategies that would have to be implemented until the doors are brought up to standard. These strategies could include, but not be limited to,

increase staff levels to assist with evacuation, especially during the night. Training in risk management strategies to give a holistic perception of risk issues found within their working environment and how to identify risk and mitigation techniques would equip nursing home managers with additional skill sets to improve the safety within the nursing homes.

The interpretation of the study results has allowed the following assumptions to be made:

The degree of current maintenance service providers do not comply or understand the application of the relevant codes and standards.

The level of expertise held by the external contractor performing the audit appears to have a level of knowledge with regards to the standards and auditing process below that required to perform the auditing, as stated within AS 4655:2005.

Where the maintenance programmes have not been implemented, the owners or occupants do not comply or understand their obligation under the relevant codes and standards.

The fire industry although self regulating appears to be ineffective in maintaining compliance.

No government licensing and certification requirements that would creating an industry of people suitably qualified for the role they performed.

A lack of legislation that incorporates performance approach and allows for removal of licenses in the event of breach of the legislative requirements. Making the industry experts accountable.

Additional education, training and awareness needs to be applied to the maintenance service provider.

The 87% non-compliance identified in the study also raised multiple non-compliance issues. In total, there were 935 non-compliance failures on the surveyed 160 doors. This

number of failures would create serious deficiencies with regards to the performance of the doors in the event of a life safety situation, removing protection from the defence in depth principles that the doors were originally installed too. Although the requirement for fire doors to be maintained has been applied since the initial release of AS1851 (1997), the doors have been significantly either overlooked or incorrectly assessed. This failure may be due, in part, through the active fire system industry who drive the benefit of their systems with examples of 97% of fire being extinguished by 10 sprinkler heads or less (National Fire Protection Association, 2007), which provides a false perception that passive fire protection is not important.

4.5 Conclusion

This chapter considered the auditing process of the fire and smoke doors and the guidelines for completion of the audit by suitably qualified auditor, as well as the implementation of guidelines that allowed for consistency and repeatability of the auditing process. The collection, analysis and consideration of the raw data was undertaken to allow interpretation of the findings to be drawn.

The uniformity of the auditing document, which identified 51 assessable items, with the auditing process adapted from Australian Standards 4655:2002 Fire Safety Auditing Guidelines, gave a robust audit process. The systems gave parity across all sections of the auditing process and allowed a consistency to be embedded in the data collection process, which helped support data's integrity. The findings were then considered against the research questions, establishing a substantial non-compliance of 87% on the fire and smoke doors structure and operation.

The data also identified a shortfall within the maintenance regimes on the fire and smoke door within the assessed nursing home, allowing for assumptions to be made. These assumptions considered a lack of suitably qualified persons within the staff pool or ownership in areas such as Risk Management, Occupational Health and Safety or Australia Building Code. The lack of legislative control over the industry combined with the no

requirement for licensing or certification allows untrained and unsupervised workers to enter the industry with no accountability.

CHAPTER 5

FINDINGS, RECOMMENDATIONS AND LIMITATIONS

5.1 Introduction

This chapter presents conclusions, recommendations and limitations of the study after analysis of the collected data findings. A summery of the study was discussed in terms of responding to the research questions and study outcomes. Recommendations were developed and limitations of the study considered. Further research is considered against the findings within the study. The chapter is finalised with the conclusion.

5.2 Summery of the Conclusions

The research questions for the study were formed in order to ascertain the level of compliance within nursing homes of the fire and smoke door maintenance. They would establish whether a reduction or an increased risk levels would be exhibited, and the resulting implications through non-compliance. The research questions were:

1. What is the measure to which fire doors and smoke doors are being maintained, when compared against the requirements defined under AS1851:2006 table 17.4.3.1 and table 17.4.4?
2. Does non-compliance with AS1851:2006 table 17.4.3.1 and table 17.4.4 increase the risk to residents in aged care facilities?

The fire and smoke doors were assessed against check sheets designed as an abridged copy of the content of AS1851:2006 tables 17.4.3.1 and 17.4.4. This assessment resulted in the fire and smoke doors surveyed, where 87% were found to be non-compliant. These failures created serious deficiencies with regards to the performance of these life safety systems.

The nature of the environment for the care of the elderly creates inherent problems such as mobility, self sufficiency, mental illness and disabilities, such as hearing and sight loss, which create high care environments. There is also a social expectation for nursing homes to care for the elderly and provide a safe and secure environment. The facility managers and owners have a duty of care, both legally under the Occupation and Health Act 1991 and morally.

The study highlighted a number of significant points of interest. The majority of the fire doors and smoke doors failed to comply with AS1851:2006. To have such a high quantitative value is unacceptable in a low risk, low traffic and low occupancy building. High non-compliance rate in an aged care building creates extremely high levels of risk exposure to life and property. The ramifications for owners, occupants and the general community managers should a fire occur within one of their facilities could be severe, with loss of life, criminal negligence and financial hardship, adverse media attention and social stigma.

There is also a requirement under the Occupational Health and Safety Act 1991 to secure and promote the health, safety and welfare of people at work. It also requires people to be protected against workplace health and safety risks and ensure that risks are identified, assessed and eliminated. If the risk cannot be removed it needs to be controlled in order to protect people against risks arising from the use of plant (Occupational Health and Safety Act, 1991).

Risk perception is an area identified as an important issue when considering the reasons for non-compliance, as it affects the understanding of what is required. For fire safety, there are two avenues that are available for risk assessment. The first is the prescriptive guidelines laid down within the Australia Building Code, which stipulates the minimum level of design and construction of building within Australia. Within the code Section C deals with Fire Resistance and Stability, Compartmentation and Separation and Protection of Openings (Building Code of Australia 2007). The second avenue is a risk based

approach termed as performance based assessments. This performance approach allowed fire engineers to study the risk within a building, perform certain qualitative risk modelling and design a solution which is site specific.

The United States Government has identified that there are some deficiencies within the prescriptive guidelines in the legislative framework with regards to the creation of codes and standards. The lack of clarity in some guidelines has made compliance with their requirements extremely difficult. This guidance document stemmed from the need expressed by National Fire Protection Authority's (NFPA) Technical Committee, who were attempting to address emerging threats (such as homeland security related issues). In addition, other aspects of risk in their documents and a recommendation particularly as some documents are moving to a more performance based. This document was meant to provide general guidance in applying risk assessment concepts and risk-informed decision-making, while also providing an elaboration on specific topics of interest by using or incorporating Fire Risk Assessment into their NFPA document (Rose, Flamberg & Leverenz, 2007).

5.3 Recommendations

Assumptions have indicated that the level of non-compliance is due to lack of industry focused skills and that the fire industry cannot provide an appropriate level of self governance to supervise practitioners. The absence of any recognised licensing regime or legislative directives has culminated in an industry that is ineffective and deficient in many areas. The study has shown that there are significant questions about compliance within the passive fire industry and its relationship to active fire systems.

The literature review showed the change in health trends, due to the onset of old age such as loss of hearing, vision difficulties and reduction in non-assisted mobility, increased level of risk apparent within the nursing home environment that would result in greater times required for evacuation of the facility in the event of a fire. It showed that the implementation of the relevant maintenance and auditing standards, as well as the accreditation process for the 9c classification, that the level of risk could be substantially

reduced with the implementation of these best practise guidelines, making the facility more secure in the event of a fire. The defence in depth principles associated with the passive fire industry allow the integrity of the fire egress corridors to be maintained for a longer period of time allowing evacuation as well as safety entry for the emergency services.

The principles behind risk identification and management, and the difference in people's perception of risk and the apparent lack of justification for certain judgements regarding risk, makes it difficult for managers of the facilities to convey the risk message. The legislative and prescriptive requirements of the owners or managers are not always apparent, either through lack of expertise within the area of nursing home risk management or the pressure for profitability. These factors may shape judgement, creating a different perception of the requirements and the risks involved.

The auditing process performed on the nursing home's fire and smoke doors produced a high non-compliance level. The level of non-compliance represents a serious increase in the risk exposure for each facility in the event of fire. This lack of compliance allows for an assumption to be made on the current system implemented on each site having significant failings. The reason for this failing may be a culmination of several issues such as suitably qualified risk experience within the management tier and training of nursing staff within the particular field, as well as an understanding of the impact of financial requirements and productivity.

Education and comprehension of risk assessment strategies within the nursing home environment, with regards to the legislative and prescriptive guidelines, will make communication of risk more effective giving an understand of the need to provide a safe and secure environment.

5.4 Limitations of the study

A number of areas limited the robustness of the study, which may have affected the outcome. The limited number of nursing homes audited needs to be increased to allow a

greater generalisation. Assumptions have been made in the extrapolation of the results to encompass the position of all nursing homes within Western Australia.

The reliance upon one specific auditor allowed for the heuristics of that person to be exhibited through risk perception from a social and culture stance. As stated by Shaw and Shaw (2001) psychological research is criticised for treating risk as purely objective, not accounting for social and cultural risk bias hidden within quantitative analysis.

An audit that has the mechanisms which would allow for any person with a basic understanding of the auditing process would give a more rounded response to the auditing process and thus the results obtained in conjunction with the auditing sheet which allows a secondary layer of duplication to be allowed.

The sample size for the study was relatively small, although it provided a consistent overview due to the relatively small number of organisations within the nursing home industry being limited. An increase within the sample size would remove the anomaly that may exist with each site having a site specific facility manager. Although fixed by the constraints of budgets and manning levels, the experience of the manager may well have changed their risk perception and resulted in a higher than average compliance level for that facility. The increase in sample size would increase the influence of the more experienced managers upon the result.

The creation of a single auditing sheet would make the auditing process more streamlined. At present, the audit of fire doors is on a different sheet to the audit for smoke doors. As all encompassing sheet would reduce the possibility of error through the completion of the incorrect sheet, while allowing a more expedient auditing and collation process.

5.5 Further Research

The completion of the study with such a high non-compliance demonstrates the inherent difficulties with management of risk within a nursing home environment. There is scope to improve the reliability of the study by encompassing a much wider sample number in order

to remove the presence of any auditing or site specific anomalies that may be encountered and have affected the results of the study. Further research would give an opportunity to test the viability of the methodology through expansion.

The study could be further expanded through the interviewing of experts within the nursing home construction, design, maintenance and management industry. The development of the building design and construction over the past years would help to establish the understanding of architects and designers on the requirements and inherent risks involved within the nursing home industry. Further extrapolation can be made by interviewing nursing home practitioners, owners and managers to establish the level of understanding of the legislative, prescriptive guidelines and to establish the appropriate skill set of the people involved. The deficiencies of skills may be resulting in the high degree of non-compliance established through this study.

The scope can be increased further by incorporating samples of other forms of health care establishment, such as hospitals and hostels. This approach would give an overview of most health service providers and identify whether the finding within this study are specific to nursing homes or symptomatic of health care establishments in general.

5.6 Conclusion

From the literature reviewed throughout the course of this study it has been well established that the need of the elderly are much greater than that of a younger demographic. Not only from lack of mobility of ill health, but also from the nature of the facility. Nursing home must, by their nature, have a degree of safety and security to prevent unauthorised access, as well as stopping wandering by sick residents. To establish such a large non-compliance rate justifies the study and addresses the need for a further, more detailed, examination.

The non-compliance identified within the study allows for several assumptions to be made of the apparent lack of suitably qualified and experienced owners and managers within the

nursing home industry. The change within the type of owners, from charitable organisations to capital venture and investment organisations, alludes to the fact that the driving motivation for the nursing home is financial reward and not the idealist notion that the elderly are a precious asset that has worked to establish the country as a world leading nation and can now be cared for by the country as thanks for their efforts.

The requirements for a stringent, more regulated industry, with independent assessors that are experienced within certain disciplines is an argument with real substance. To have a third party, with no competing agenda, whose sole motivation is the safety and comfort of the residents and staff has real merit. The current assessment system is an example of where self governance fails to some degree. The assessment of the homes safety and comfort with a higher focus on fire safety is a foundation stone that need to be built on. The auditing process, once every three years, allow managers and owners alike to forget about the safety issues until re-certification is required. The annual declaration for compliance with legislative requirements for fire safety within a state like Western Australia, which has no legislative requirement, makes the process dependent upon the risk perception and legislative understanding of the person signing the form.

The requirement for compliance within the maintenance and auditing areas could possibly be better served by the insurance companies expressing their need for full compliance, regardless of legislative requirement. To provide a safe well maintained nursing home will reduce the loss of life and property and perhaps reduce the premium.

REFERENCE

- Arcuri, A. (2007). Reconstructing precaution, deconstructing misconceptions. *Ethics & International Affairs*, 21(3), Pages 359 – 379, Retrieved January 11th 2007 from <http://www3.interscience.wiley.com/journal/117999038/abstract?CRETRY=1&SRETRY=0>
- Ashe, B.S.W. McAneney, J. & Pitman, A.J. (2008). The cost of fire in Australia risk frontiers, Sydney: Macquarie University Press.
- Australian Building Code Board. (2001). *Fire safety engineering guidelines* (2nd ed.). Canberra: Australian Building Code Board.
- Australian Building Code Board. (2005). *Building code of Australia*. Canberra: Australian Building Code Board.
- Australian Bureau of Statistics. (2006). *National health survey: Summary of Results*. Retrieved January 13th 2008 from <http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/4364.02004-05?OpenDocument>
- Australian Bureau of Statistics. (2008a). *Health of older people in Australia: A Snapshot, 2004-05*. Retrieved December 11th 2007, from <http://www.abs.gov.au/ausstats/abs@.nsf/mf/4833.0.55.001>
- Australian Government. (1991). *Occupational health and safety Act*, Canberra: Australian Government.
- Australian Government. (1997). *Aged care Act*. Canberra: Australian Government.

- Australian Government. (2006). Department of Health and Aging. *Aged care in Australia*. Canberra: Australian Government. Retrieved May , 22nd 2008, from <http://www.health.gov.au/hsdd/mentalhe>
- Blade, A. (2001). *Security and risk management*. Perth: Edith Cowan University Publication.
- Bogdan, R. F., & Biklen, S. (1992). *Eight common questions about qualitative research in Qualitative research for education: An Introduction to theory and methods*. Boston: Allyn & Bacon.
- Broder, J. F. (1984). *Risk analysis and the security survey*. Boston: Butterworth Heinemann.
- Brooks, D.J. (2006). Mapping the consensual knowledge of security risk management experts. *Proceeding of the 7th Australian Information Warfare and Security Conference* (pp. 9-17) Perth: School of Computer and Information Science, Edith Cowan University.
- Bruck, D. (2001). The who, what, where, and why of waking to fire alarms: A Review. *Fire Safety Journal*, 36, 623-639.
- Burns, S., & Grove, S.K. (2001). *The practice of nursing research: conduct, critique and validity* (4th ed.). New York: WB Saunders
- Cantrell, D. C. (n.d.). *Alternative paradigms in environmental education research: The interpretive perspective*. Retrieved August 12th 2007, from http://www.edu.uleth.ca/ciccte/naceer.p_gs/pubpro.pgs/alternate/pubfiles/08.Cantrell.fin.htm

- Carmines, E. & Zeller, R. (1991). *Reliability and validity assessment*. Beverly Hills: Sage.
- Chess, C. (2001). Organizational Theory and the Stages of Risk Communication. *Risk Analysis*, V.21, No.1, 12-23
- Child, I. L. (1954). Personality. *Annual Review of Psychology*, 5, 149-170. Retrieved January 11th 2007, from <http://arjournals.annualreviews.org/doi/pdf/10.1146/annurev.ps.05.020154.001053?cookieSet=1>
- Chisnall, P. M. (1986). *Marketing Research*. Maidenhead, UK: McGraw-Hill.
- Covello, V. & Merkhofer, M. (1993). 1003. *Risk assessment methods: Approaches for assessing health and environment risk*. New York: Plenum Press.
- Denzin, N. K., & Lincoln, Y. S. (1994). *Introduction: Entering the Field of Qualitative Research*. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of Qualitative Research* 1-11. Thousand Oaks, CA: Sage.
- Denardo, E. (2002). In *The science of decision making: a problem-based approach using excel*. New York: Wiley.
- Douglas, M. (1978). *Cultural bias*. Occasional Paper No. 35. London: Royal Anthropological Institute of Great Britain & Ireland.
- Evensky, H. & Katz, D. B. (2004). *The investment think tank: theory, strategy, and practice for advisers* (1st ed.). Princeton, NJ: Bloomberg Press.
- Fay, J. J. (1993). *Butterworth's Security Directory: Terms and concepts*. Boston: Butterworth Heinemann.

- Frantzieh, J. & Hakan, L. (1998). *Uncertainty and risk analysis in fire safety engineering*. Sweden: Department of Fire Safety Engineering, Lund Institute of Technology, Lund University.
- Fischhoff, B. & Slovac, P. (1981). *Acceptable risk*. New York: Cambridge University Press.
- Finke, R. A., Ward, T. B., & Smith, S. M. (1996). *Creative cognition: theory, research, and applications*. Cambridge, Massachusetts: MIT Press.
- Gabrel, C., & Jones, A., (2000). *The national nursing home survey: 1995 summary*, National Centre for Health Statistics, Vital Health Stat 13 (146) 2000, pp. 4, 8, 20, and 22. Retrieved February 15th 2008, from <http://www.cdc.gov/nchs/about/major/nnhsd/nnhslist.htm>
- Garrity, T.J., (2000) *A public education program to prevent oxygen-therapy fires: Strategic analysis of community risk reduction*, National Fire Academy applied research project as part of the Executive Fire Officer Program, 2000.
- Grewal, D. Gotlieb, J. & Marmorstein, H. (1994). The moderating effects of message framing and source credibility on the price-perceived risk relationship. *Journal of Consumer Research*, 21(1), 145-153.
- Gurdon Z. A. (2007), *A study of the impact of the affect heuristic on the risk perception of security experts*. Unpublished Bachelor of Science dissertation, Edith Cowan University, Perth, Western Australia.

- Hall, J. R. (2006a). *Characteristics of home fire victims including age and sex*, Quincy, MA: National Fire Protection Association,
- Hall, J.R. (2006b). *The smoking material fire problem*, Quincy, MA: National Fire Protection Association,
- Helmerts, E. N. & Schaller, L.C. (1982). *Calculated process risk and hazard management*. Plant/ Operation Progress, 1(3), AICHE.
- Jones, A. (2000). *The national nursing home survey: 1999 Summary*, National Centre for Health Statistics, Vital Health Stat 13 (152) 2000, pp. 6 - 25. Retrieved January 11th 2007, from www.cdc.gov/nchs/about/major/nnhsd/nnhslist.htm
- Lethbridge-Cejku, M. Schuller, J.S. & Bernadel, L. (2002). *Summary health statistics for U.S. adults: national health interview survey, 2002*. National Center for Health Statistics, Vital Health Stat 10 (222) 2004, pp. 38, 50. Retrieved January 11th 2007, from www.cdc.gov/nchs/data/series/sr_10/sr10_222.pdf
- Lincoln, Y., & Guba, E. G. (1985). *Naturalistic inquiry*. Newbury Park: California.
- National Fire Protection Association (2004). 551, *Guide to fire safety concepts tree* (4th ed.). Quincy, Massachusetts: National Fire Protection Association.
- Marris, C., Langford, I., & O’Riordan, T. (1998). A quantitative test of the culture theory of risk perception: Comparison with the psychometric paradigm. *Risk Analysis*, 18(5), published on behalf of the Society for Risk Analysis 2000.
- Office of the State Fire Marshal, Massachusetts Department of Fire Services (2004). *The Massachusetts fire problem: Annual report of the Massachusetts fire, incident*

reporting system. Retrieved February 12th 2007, from
www.mass.gov/dfs/osfm/statistics/

Peters, R. G., Covello, V. T. and McCallum, D. B. (1997). The determinants of trust and credibility in environmental risk communication: An Empirical Study. *Risk Analysis*, 17(1), McLean: Society for Risk Analysis.

Rose, S. Flamberg, S. & Leverenz, F. (2007). *Guidance document for incorporating risk concepts into NFPA codes and standards*: The Fire Protection Research Foundation, Quincy, Massachusetts: National Fire Protection Association

Robbins, S. P., Millet, B., & Waters-Marsh, T. (2004). *Organisational behaviour*. Sydney: Frenchs Forest.

Sarantzouklis, S. (2005). *Fire risk management plan implementation manual*. Sydney: Fire Protection Association.

Spiker, C. C., & McCandles, B. R. (1954). The concept of intelligence and the philosophy of science. *Psychology Review*, 61, 255-267.

Sjoberg, L. (2000). Factors in Risk Perception. *Risk Analysis*, 20 (1), McLean: Society for Risk Analysis,

Standards Australia. (2004). *Risk management 4360*. Sydney: Standards Australia.

Standards Australia. (2005a). *Australian Standards 4566, Fire engineering auditing*. Sydney: Standards Australia.

Standards Australia. (2005b). *Australian Standards 1851. Maintenance of fire protection systems and equipment*. Sydney: Standards Australia.

- Standards Australia. (2005c). *Australian Standards AS1905.1:2005 Fire resistant door sets*, Sydney: Standards Australia.
- Society of Fire Protection Engineering. (2006). *Engineering guide of fire risk assessment*, Final Ballot Draft: National Fire Protection Association.
- Slovic, P. (1987). Perception of risk. *Science*, 236, (280-285). in Vanderveen G. (2006): *Interpreting Fear, Crime, Risk And Unsafety: Conceptualisation and Measurement*. Boom Juridische: Uitgevers.
- Michael T. Ellis R. & Wildavsky A. (1990). *Cultural theory*. Boulder: Westview.
- U.S. Census Bureau (2003) *Statistical abstract of the United States table 64: (123rd edition)*, Washington DC. Retrieved January 12th 2007, from <http://www.census.gov/prod/1/pop/p23-190/p23-190.pdf>
- United States Food & Drug Administration. (2002). Initiation and conduct of all “major” risk assessments within a risk analysis framework, *A Report by the CFSAN Risk Analysis Working Group*, retrieved January 12th 2007, from <http://www.cfsan.fda.gov>
- United States Centre for Disease Control and Prevention. (2007). *National Hospital discharge survey 2001* Retrieved January 11th 2007 from, <http://www.cdc.gov/nchs/data/ad/ad332.pdf>
- Wooldridge (2008). *Australian study on people living with psychotic illness between 1997 and 1998*, Retrieved January 11th 2007, from <http://www.dhw.wa.gov.au>.
- Western D. Burton L. & Kowalski R. (2006). *Psychology: Australian and New Zealand edition*. Queensland: John Wiley & Sons.

West Australian Local Government. (1960), *Western Australian consolidated acts local government (miscellaneous Provisions) Act 1960* Perth: West Australian Local Government.

FIRE & SMOKE DOOR INSPECTIONS

67